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Docket No.: 509982005500
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
Srinivas DODDI et al.

Application No.: 10/608,300

Confirmation No.: 9021

Filed: June 27, 2003

Art Unit: 2121

For: MACHINE LEARNING METHODS FOR SEMICONDUCTOR METROLOGY

Examiner: N. Brown

REPLY BRIEF

MS Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

This Reply Brief is filed in response to the Examiner's Answer, dated June 12, 2007, in the above-referenced matter.

sf-2372181

I. STATUS OF CLAIMS

A. Total Number of Claims in Application

There are 29 claims pending in application.

B. Current Status of Claims

1. Claims canceled: 0
2. Claims withdrawn from consideration but not canceled: 0
3. Claims pending: 1-29
4. Claims allowed: 0
5. Claims rejected: 1-29

C. Claims on Appeal

The claims on appeal are claims 1-29

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II. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

A. Whether claims 1-6, 11-14, and 16-29 are patentable under 35 U.S.C. § 103(a) over U.S. Patent No. 6,650,422 (the Singh reference) in view of U.S. Patent No. 6,192,103 (the Wormington reference).

B. Whether claims 9-10 and 15 are patentable under 35 U.S.C. § 103(a) over the Singh reference in view of the Wormington reference and further in view U.S. Patent No. 6,665,446 (the Kato reference).

C. Whether claim 7 is patentable under 35 U.S.C. § 103(a) over the Singh reference in view of the Wormington reference and further in view of EP Patent No. 0 448 890 (the Sirat et al. reference).

D. Whether claim 8 is patentable under 35 U.S.C. § 103(a) over the Singh reference in view of the Wormington reference and further in view of Gahegan et al "Dataspaces as an organizational concept for the neural classification of geographic datasets", 1999.

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III. ARGUMENTS

A. Claims 1-6, 11-14, and 16-29

The Examiner rejected claims 1-6, 11-14, and 16-29 under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 6,650,422 (the "Singh reference") in view of U.S. Patent No. 6,192,103 (the "Wormington reference"). Independent claims 1, 16, and 22 recite that the second simulated diffraction signal is generated **as an output of the machine learning system**. The primary disagreement between Examiner and Appellants appears to be whether the Wormington reference discloses this claim element.

As Appellants previously explained, "[t]he Wormington reference discloses using a genetic algorithm, particularly an evolutionary algorithm, **to form a new parameter vector** ... and not a diffraction signal. Thus, the output of the genetic algorithm is a new parameter vector rather than the X-ray scattering." (Appeal Brief, at 6.) In contrast, claims 1, 16, and 22 explicitly recite that the second simulated diffraction signal is generated as an output of the machine learning system. Note, claims 1, 16, and 22 do not merely recite that the second diffraction signal is an output. Rather, claims 1, 16, and 22 expressly recite that the second simulated diffraction signal is an output of the machine learning system.

It is Appellants' understanding that the Examiner has construed:

> "profiles" as corresponding to "models" and "parameter vectors" in the Wormington reference;
>
> "diffraction signals" as corresponding to "X-ray scattering" in the Wormington reference; and
>
> "machine learning systems" as corresponding to "genetic algorithms" in the Wormington reference.

PAGE 9/18 * RCVD AT 8/13/2007 9:06:58 PM [Eastern Daylight Time] * SVR:USPTO-EFXRF-3/7 * DNIS:2738300 * CSID:415 2687522 * DURATION (mm-ss):05-42

Column 6, lines 14-16, of the Wormington reference clearly disclose that the computed simulation generated as an output of step 34 is the X-ray scattering. However, the Wormington reference does not disclose the use of genetic algorithms at step 34. Genetic algorithms are not used until step 40. Column 8, lines 3-7, disclose, "the adjustment of the model parameters at step 40, to obtain the best fit, is carried out with the use of genetic algorithms." Accordingly, the output of the genetic algorithms at step 40 is adjusted model parameters, not X-ray scattering. Because the X-ray scattering (corresponding to step 34) exists before the genetic algorithms are used to adjust the model parameters (corresponding to step 40), X-ray scattering cannot be the output of the genetic algorithms in the Wormington reference.

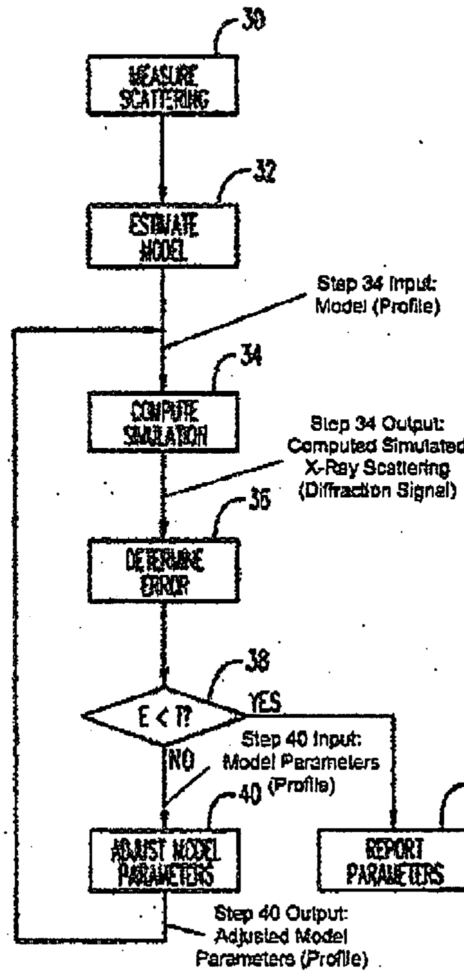

FIG. 1. This flowchart is an annotated version of FIG. 4 of the Wormington reference

The claims of the Wormington reference further show that X-ray scattering is not an output of the genetic algorithms in the Wormington reference. For example, claim 1 of the Wormington reference recites:

> 1. A method for estimating parameters of a material, comprising the steps of:
>
> obtaining experimental x-ray scattering data which is indicative of parameter value for the material;

<u>estimating a model for the material and calculating simulated x-ray scattering data for the estimated model</u>.
comparing the experimental and simulated x-ray scattering data to generate an error value;
<u>modifying the model by means of an evolutionary algorithm to reduce said error value</u>; and
reporting the parameter values which characterize the modified model as an estimate of the parameter values for the material. (Emphasis added.)

Note, "the model" is modified by the evolutionary algorithm in the "modifying" step of claim 1. The antecedent basis for term "the model" in the "modifying" step is the term "a model" recited in the "estimating" step. The simulated x-ray scattering data is calculated "for the estimate model," which is estimated in the "estimating step" prior to "the model" being modified in the "modifying" step by the evolutionary algorithm. Thus, as recited in claim 1, a model is estimated, then a simulated x-ray scattering data is calculated for the estimated model. An evolutionary algorithm is used to modify the model rather than calculate the simulated x-ray scattering data. Thus, the simulated x-ray scattering data is the output of the "calculating" step rather than the "modifying the model" step in which the evolutionary algorithm is used.

Examiner states that the Singh reference fails to disclose obtaining a second diffraction signal using a machine learning system, wherein the machine learning system receives as an input one or more parameters that characterize a profile of the structure to generate the second diffraction signal, recited in independent claims 1, 16 and 22. Thus, neither the Singh nor the Wormington reference, individually or in combination, teach or suggest using a machine learning system to generate a simulated diffraction signal as an output of the machine learning system.

In the following sections, Appellants follow Examiner's Answer's order of argumentation.

1. New Parameter Vector is Output of Genetic and Evolutionary Algorithms in Wormington Reference

Examiner asserts:

> Appellants have shown that Wormington's invention uses parameter vectors which act as diffraction signals. Examiner notes that Appellants also disclose the use of parameter vectors, called profiles, in various paragraphs in the Specification. See for instance, para. 0020
>
> > [0020] More specifically, each diffraction signal in the library is associated with a profile of the structure.
>
> And para. 0022
>
> > [0022] The set of profiles stored in library 116 can be generated by characterizing a profile using a set of parameters, then varying the set of parameters to generate profiles of varying shapes and dimensions. The process of characterizing a profile using a set of parameters can be referred to as parameterizing.
>
> Reference may also be made to para.: 0024, 0025, 0035, 0044, 0055, and 0059. Simply put, Appellants' inventions creates a set of parameters and the invention for Wormington creates a set of parameters and it is these parameters that are matched. There are no actual diffraction signals in the computer until a transformation is made, in each case, to the parameters that represent the signal.
>
> Clearly, there is no difference between Appellants and Wormington in the representation of diffraction signals.

Appellants respond:

Appellants respectfully disagree with Examiner's assertion that "Appellants have shown that Wormington's invention uses parameter vectors which act as diffraction signals." (Examiner's Answer, at 8.) Applicants have not asserted that the parameter vectors "act" as diffraction signals. The Wormington reference discloses that, "X-ray scattering data is simulated for the parameters of each parameter vector…." (Wormington reference, col. 9, ll. 45-58.) Thus, parameter vectors do not "act" as diffraction signals. Instead, the parameters of a parameter vector are used in simulating an X-ray scattering data.

Additionally, Appellants respectfully disagree with Examiner's assertion that "[s]imply put, Appellants' invention creates a set of parameters and the invention of Wormington creates a set of parameters and it is these parameters that are matched." (Examiner's Answer, at 8.) Claims 1, 16, and 22 specifically recite that diffraction signals are compared.

Examiner asserts:

> One of the most often executed steps found in working programs is: 'increment the accumulator'. This step is used to count the number of times loops are performed. The accumulator increment operation produces no output. To break out of a loop, a program compares the contents of the accumulator to some value held in the register. Clearly, Appellants' assertion that "when a step of a process is performed, there is an output of that step" is generally false. Since we cannot rely on the existence of output produced by any step of a program or algorithm, it is critical to discern where in a program output occurs, or is supposed to occur. This is one of the things a flowchart shows with an 'input/output box' (i.e., parallelogram) (*see* http://www.edrawsoft.com/flow-chart-design.php). Appellants' argument below is dependent on such discernment. Neither Appellants' Fig. 4 nor Wormington's Fig. 4 show a diffraction signal in an input/output box.
>
> ...
>
> Neither step 40 nor steps 34 are indicated in the flowchart, with standard symbols, to produce output. Thus, the computed simulation is deemed to be merely the *result* of having performed step 34. Further, Appellants' argument that "Because step 34 is performed before step 40, the computed simulation exists before the adjusted model parameters." Ignores the fact that step 34 comes *after* step 32, in which the model parameters are estimated from "X-ray scattering data for a specimen being tested" (*see* col. 6, lines 5-8). Thus, the first time through the loop, the computed simulation exists *after* a computation of the model parameters at step 32. Thereafter, because control is in a loop, the computed simulation exists *after* a computation of the model parameters at step 40.
>
> ...
>
> Column 6, lines 14-16 recite: "Once the model has been estimated, the X-ray scattering, for that model is simulated at step 34, using known methods...". Since neither the text nor the flowchart indicate an 'output', the inference of such, on the part of the Appellants, is problematic.

Appellants respond:

Appellants disagree with Examiner's asserted distinction between the "output" and the "result" of a step of a process. Nevertheless, it should be noted that, if accepted, Examiner's argument that the simulation of X-ray scattering at step 34 of the Wormington reference **is *not* an output** is actually self-defeating. Without disclosing X-ray scattering (or diffraction signals) as an "output" of genetic algorithms, *ipso facto*, a required claim element of the present Application is not disclosed by the Wormington reference.

Appellants also disagree with Examiner's following assertion:

> Thus, the first time through the loop, the computed simulation exists *after* a computation of the model parameters at step 32. Thereafter, because control is in a loop, the computed simulation exists *after* a computation of the model parameters at step 40.

(Examiner's Answer, at 10.) Regardless the number of times that the loop is completed, the Wormington reference does not disclose the use of genetic algorithms at steps 32 or 34 to output X-ray scattering. Additionally, contrary to Examiner's claim, the model at step 32 is not the result of a "computation of the model parameters." Instead, the model at step 32 is estimated using information that an operator knows about features of the structure and/or the operator's "best guess" about features of the structure. (*See* Wormington reference, col. 6, ll. 7-14.)

Examiner asserts:

> Genetic algorithms do more than adjust parameters (*see* Wormington, column 8, lines 7-17). Genetic algorithms test whether a chromosome (i.e., vector) maximizes (or minimizes) some fitness function. The test in Wormington is clearly at step 38, thus the boundary of the genetic algorithm is not at step 40. Another thing that genetic algorithms do is establish initial populations (*see* Hassoun, "Fundamentals of Artificial Neural Networks, 1995, p. 440, "To start the genetic search, an initial population...is created."). Wormington teaches that: "In the context of X-ray scattering, therefore, the initial population comprises sets of the parameters that are used to characterize a specimen." (*see* col. 8, lines 14-17). Examiner interprets "the initial population" to be simulated data created at step 34. Therefore, step 34 is functionally part of the genetic algorithm. Thus,

> the data representing two (or more) X-ray scatterings (or diffraction signals) is clearly a result of computations inside the genetic algorithm of Wormington's invention and *could* be indicated to be the output of the genetic algorithm with the appropriate flowchart symbol.

Appellants respond:

Regardless the accuracy of Examiner's general statements that "[g]enetic algorithms do more than adjust parameters" and that "[a]nother thing that genetic algorithms do is establish initial populations", the fact remains that Examiner has not shown that the Wormington reference itself discloses the use of the genetic algorithm to output X-ray scattering. (Examiner's Answer, at 11.)

Appellants disagree with Examiner's assertion that "[t]he test in Wormington is clearly at step 38, thus the boundary of the genetic algorithm is not at step 40." (Examiner's Answer, at 11.) At step 36 of the Wormington reference, an error value is generated based on the difference between the X-ray scattering that was measured at step 30 and the X-ray scattering that was simulated at step 34. (*See* Wormington reference, at col. 6, ll. 18-23.) At step 38, a determination is made whether the error value from step 36 is less than a threshold value. (*See id.*, at col. 6, ll. 23.) The Wormington reference does not disclose the use of genetic algorithms to determine whether the error value is greater than the threshold value at step 38.

Examiner erroneously "interprets 'the initial population' to be simulated data created at step 34." (Examiner's Answer, at 11-12.) As Examiner notes, the Wormington reference provides that the "initial population" comprises sets of "parameters." (Examiner's Answer, at 11 (citing Wormington reference, col. 8, ll. 14-17 (providing that "the initial population comprises various sets of the parameters that are used to characterize a specimen")).) The Wormington reference provides examples of "parameters" including characteristics of the structure of the specimen such as roughness, density, and thickness. (*See, e.g.,* Wormington reference, col. 8, ll. 44-56.) Further, the Wormington reference provides, "[o]nce the initial population is complete, X-ray scattering data is simulated for the parameters of each parameter vector...." (Wormington reference, col. 9, ll. 45-48.) Accordingly, if the X-ray scattering data is simulated *after* the initial

population is *complete*, then the initial population itself is not simulated X-ray scattering. Thus, the initial population in the Wormington reference is not X-ray scattering, but rather it is, as the Wormington reference explicitly explains, "sets of the parameters that are used to characterize a specimen."

Appellants also disagree with Examiner's assertion that step 34 of the Wormington reference is "functionally" a part of the genetic algorithm. (*See* Examiner's Answer, at 12.) By stating that X-ray scattering "could" have been indicated to be the output of the genetic algorithm with the appropriate flowchart symbol, Examiner seemingly acknowledges that the Wormington reference in fact does not disclose X-ray scattering as an output of the genetic algorithm. (*See id.*)

In sum, Examiner has failed to show that X-ray scattering is the output of the genetic algorithms in the Wormington reference. In fact, as previously explained, Examiner affirmatively argues that the simulated X-ray scattering at step 34 is not an "output" at all.

2. Singh Reference Fails to Disclose Diffraction Signal Generated Using Machine Learning System

The Examiner states that the Singh reference fails to disclose obtaining a second diffraction signal using a machine learning system, wherein the machine learning system receives as an input one or more parameters that characterize a profile of the structure to generate the second diffraction signal, recited in independent claims 1, 16 and 22.

Therefore, Appellants assert that claims 1, 16, and 22 are allowable because neither the Singh nor the Wormington reference, individually or in combination, teach or suggest using a machine learning system to generate a simulated diffraction signal **as an output of the machine learning system**. Additionally, Appellants assert that claims 2-6, 11-14, 17-21, and 23-29 are allowable for at least the reason that they depend on an allowable independent base claim.

B. Claims 9-10 and 15

The Examiner rejected claims 9-10, and 15 under 35 U.S.C. 103(a) as being unpatentable over the Singh reference in view of the Wormington reference and further in view of US Patent No. 6,665,446 (the "Kato reference").

The rejection of claims 9-10 and 15 should be reversed for at least the reason that they depend on an allowable independent base claim.

C. Claim 7

The Examiner rejected claim 7 under 35 U.S.C. 103(a) as being unpatentable over the Singh reference in view of the Wormington reference and further in view of EP Patent No. 0 448 890 (the "Sirat et al. reference").

The rejection of claim 7 should be reversed for at least the reason that it depends on an allowable independent base claim.

D. Claim 8

The Examiner rejected claim 8 under 35 U.S.C. 103(a) as being unpatentable over the Singh reference in view of the Wormington reference and further in view of Gahegan et al "Dataspaces as an organizational concept for the neural classification of geographic datasets", 1999.

The rejection of claim 8 should be reversed for at least the reason that it depends on an allowable independent base claim.

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IV. CONCLUSION

For the foregoing reasons, Appellants respectfully assert that the Examiner's rejections of claims 1-29 are erroneous and that the claims are patentable. Reversal of the rejections is therefore requested.

The Commissioner is hereby authorized to charge any additional fees under 37 C.F.R. § 1.17 that may be required by this Reply Brief to the Examiner's Answer, or to credit any overpayment, to Deposit Account No. 03-1952 referencing attorney docket no. 509982005500.

Dated: August 13, 2007

Respectfully submitted,

By ________________

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